Synopsis

"Studies on Green Synthesis, Physicochemical Properties and Characterization of Platinum, Silver and Gold nanoparticles and its Applications in various fields"

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1. Introduction

Green nanotechnology, a resultant field and a developing department of a nanotechnology is of awesome intrigued to inquire about ponders around the world. It is the perfect arrangement to lower the chance of nanotechnology by lessening the antagonistic results of the generation and application of nanomaterials [1]. NPs have reliably pulled in researchers due to their potential utilize in major businesses for illustration building, agribusiness, and pharmaceutical. Nanomaterials have a wide run of commonsense employments since of their specific optical, catalytic, electrical, and physical characteristics [2]. Due to their interesting chemical, photochemical, electrical, and optical properties, metallic nanoparticles and their combinational analogs have drawn a parcel of intrigued [3]. Respectable metallic nanoparticles are respected as profoundly particular and flexible operators. They have so numerous organic applications. Green strategies don't require vitality, tall weight, tall temperatures, or dangerous chemicals. The green blend method has a few benefits over conventional chemical and physical methods. It is additionally more reasonable, ecologically inviting, and basic to construct up for large-scale generation [4-7]. The application of plant-based diminishing, capping, and stabilizing specialists without the utilize of unsafe, costly, or energy-intensive chemicals is drawing the consideration of analysts these days [8]. Since they have huge sums of bioactive auxiliary metabolites with critical diminishment potential, plants are respected to be a fantastically suited framework for the creation of nanoparticles [9]. Metallic particles may be changed over into physiologically dynamic nanoparticles more rapidly by means of naturally neighborly conventional biosynthetic forms in plants that incorporate compounds with organic movement [10]. In expansion to Nano science and nanotechnology, material science, chemistry, science, atomic building, and others, these ranges are quickly creating. Nanomaterials are items that have been treated with nanotechnologies and incorporate nanoparticles (NPs) of measure extending from 1 to 100 nm. Nanotechnology is really a multidisciplinary science where physicist, chemists, scientists and pharmaceutical researcher all have played major parts to create novel treatment and diagnosing modalities. Inside past few decades, nanotechnology, in specific fabricating of nanoparticles has found an exceptional consideration in wide zones of science [11]. The intelligent utilize of nanoparticles has revolutionized how drugs are defined and conveyed. Nanotechnology may be a multi-disciplinary scientific field applying designing and fabricating standards at the atomic level [12]. By applying nanotechnology to pharmaceutical, nanoparticles have been made to imitate or modify natural forms [13]. Nanoparticles are strong, colloidal particles with estimate run from 10 nm to 100 nm. However in any case, for

nanomedical application, the particular measure is less than 200 nm [14]. The significance of these materials realized when analysts found that measure can influence the physico-chemical properties of a substance e.g. the optical properties. A 20nm gold (AuNPs), platinum (PtNPs), silver (AgNPs), and palladium (PdNPs) NPs have characteristic wine ruddy color, yellowish gray, dark and dull dark colors, individually. These NPs appeared characteristic colors and properties with the variety of measure and shape, which can be utilized in bio-imaging applications [15]. Among these nanoparticles, platinum nanoparticles (PtNPs) have started extraordinary intrigued owing to their special basic, optical, catalytic properties, tall surface region, and great resistance to erosion making them a potential candidate for catalysis and biomedical applications [16, 17]. Plants are utilized in PtNPs union since they are less complex, smoother, eco-friendly, strong, and cost-effective, and they deliver more steady synthesized particles than other, more standard approaches [18]. NPs are not straightforward particles itself and thus composed of three layers i.e. (a) The surface layer, which may be functionalized with a assortment of little atoms, metal particles, surfactants and polymers. (b) The shell layer, which is chemically diverse fabric from the center in all viewpoints, and (c) The center, which is basically the central parcel of the NP and as a rule alludes the NP itself [19].

Classification of NPs

NPs are broadly separated into different categories depending on their morphology, estimate and chemical properties. Based on physical and chemical characteristics, a few of the well-known classes of NPs are given as below.

Carbon-based NPs

Fullerenes and carbon nanotubes (CNTs) state to two major classes of carbon-based NPs. Fullerenes contain nanomaterial that is made of globular empty cage such as allotropic shapes of carbon. It is utilized in numerous commercial applications such as fillers [20].

Metal NPs

Metal NPs are simply made of the metals forerunners. Due to well-known localized surface plasmon reverberation (LSPR) characteristics, these NPs have one of kind optoelectrical properties. NPs of the soluble base and respectable metals i.e. Cu, Ag and Au have a wide retention band within the obvious zone of the electromagnetic sun based range. The aspect, measure and shape controlled union of metal NPs is imperative in display day cutting-edge materials. Due to their progressed optical properties, metal NPs find applications in numerous investigate regions. Gold NPs coating is broadly utilized for the inspecting of SEM, to improve the electronic stream, which makes a difference in getting tall quality SEM images.

Ceramics NPs

Ceramics NPs are inorganic nonmetallic solids, synthesized by means of warm and progressive cooling. They can be found in nebulous, polycrystalline, thick, permeable or empty shapes [21]. In this manner, these NPs are getting extraordinary consideration of analysts due to their utilize in applications such as catalysis, photocatalysis, photodegradation of colors, and imaging applications [22].

Semiconductor NPs

Semiconductor materials have properties between metals and nonmetals and so they found different applications within the literature due to this property [23, 24]. Semiconductor NPs have wide band holes and thus appeared significant modification in their properties with band hole tuning. Subsequently, they are exceptionally imperative materials in photocatalysis, photo optics and electronic gadgets [25]. As a case, assortment of semiconductor NPs are found uncommonly efficient in water splitting applications, due to their appropriate band gap and band edge positions [26].

Polymeric NPs

These are ordinarily natural based NPs and within the writing an uncommon term polymer nanoparticle (PNP) collective utilized for it. They are generally nanospheres or nanocapsular formed [27]. The previous are matrix particles whose in general mass is for the most part strong and the other particles are adsorbed at the external boundary of the round surface. Within the last mentioned case the strong mass is typified inside the molecule totally [28]. The PNPs are promptly functionalized and hence find bundles of applications within the writing [29, 30].

Lipid-based NPs

These NPs contain lipid moieties and successfully utilizing in numerous biomedical applications. By and large, a lipid NP is characteristically circular with breadth extending from 10 to 1000 nm. Like polymeric NPs, lipid NPs have a strong center made of lipid and a framework contains dissolvable lipophilic atoms. Surfactants or emulsifiers stabilized the outside center of these NPs [31]. Lipid nanotechnology could be a uncommon field, which center the planning and blend of lipid NPs for different applications such as sedate carriers and conveyance [32] and RNA discharge in cancer treatment [33].

Synthesis of nanoparticles

Several strategies can be utilized for the blend of NPs, but these strategies are broadly separated into two primary classes i.e. (1) Bottom-up approach and (2) Top-down approach [34].These approaches advance partition into different subclasses based on the operation, response condition and embraced protocols.

Top-down amalgamations

In this strategy, dangerous approach is utilized. Beginning from bigger particle, which decayed into littler units and after that these units are changed over into appropriate NPs. Cases of this strategy are grinding/milling, CVD, physical vapor testimony (PVD) and other deterioration strategies [35]. This approach is utilized to synthesize coconut shell (CS) NPs. The processing strategy was utilized for this reason and the crude CS powders were finely processed for different interval of times, with the assistance of ceramic balls and a well-known planetary process.

Bottom-up syntheses

This approach is utilized in turn around as NPs are formed from generally less complex substances; in this manner this approach is additionally called building up approach. Cases of this case are sedimentation and decrease procedures. It incorporates sol gel, green amalgamation, turning, and biochemical blend [35].

Green and biogenic bottom-up union

Recently in this range numerous analysts pulled in due to the achievability and less harmful nature of forms. These forms are cost-effective and natural inviting, where blend of NPs is finished by means of natural frameworks such as utilizing plant extricates. Microbes, yeast, organisms, *Aloe vera*, tamarind and indeed human cells are utilized for the union of NPs. Au NPs has been union from the biomass of wheat and oat [36] and utilizing the microorganism and plant extricates as decreasing operator [37]. Kharat and Mendhulkar [38] synthesized Silver nanoparticles from plant leaf extricates of *Elephantopus scaber* (L).

Characterization of NPs

Various characterization methods have been practiced for the investigation of numerous physicochemical properties of NPs. These incorporate methods such as X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), infrared (IR), SEM, TEM, and molecule measure analysis.

Morphological characterization

It is done utilizing polarized optical microscopy (POM), SEM and TEM, etc.

Structural characterization

XRD, vitality dispersive X-ray (EDX), XPS, IR, Raman, Wagered, and Zieta measure analyzer are the common methods utilized to think about basic properties of NPs.

Particle measure and surface range characterization

These incorporate SEM, TEM, XRD, AFM, and energetic light scrambling (DLS). SEM, TEM, XRD and AFM can allow superior thought almost the molecule measure [39]. Within the think about Sikora et al. utilized DLS method to examine the measure variety of silica NPs with assimilation of proteins from serum.

Optical characterizations

Optical properties are of extraordinary concerned in photocatalytic applications and thus, photo-chemists obtained great information of this method to uncover the component of their photochemical forms. These characterizations are based on the popular beer-lambert law and fundamental light standards [40]. These procedures allow data approximately the retention, reflectance, radiance and glow properties of NPs. Ultraviolet visible (UV-Vis), photoluminescence (PL) and the invalid ellipsometer are the well-known optical disobedient, which can be utilized to think about the optical properties of NPs materials.

Physicochemical properties of NPs

Various physicochemical properties such as expansive surface zone, mechanically solid, optically dynamic and chemically receptive make NPs one of a kind and reasonable candidates for different applications.

Electronic and optical properties

The optical and electronic properties of NPs are forbid to more prominent degree. For occasion, respectable metals NPs have estimate subordinate optical properties and show a strong UV-visible termination band that's not show within the range of the bulk metal.

Magnetic properties

Magnetic NPs are of extraordinary interest for examiners from an diverse extend of disciplines, which incorporate heterogenous and homogenous catalysis, biomedicine, attractive fluids, information capacity attractive reverberation imaging (MRI), and natural remediation such as water cleaning. The writing uncovered that NPs perform best when the measure is next to these parameters surface coating, coagulation, and oil moreover help to mechanical properties of NPs [42].

Thermal properties

It is well-known truth that metals NPs have warm conductivities higher than those of fluids in strong shape. For case, the warm conductivity of copper at room temperature is around 700 times more prominent than that of water and around 3000 times more prominent than that of motor oil. Indeed oxides such as alumina (Al_2O_3) have warm conductivity higher than that of water. Subsequently, the fluids containing suspended strong particles are anticipated to show significantly upgraded warm conductivities relative to those of customary warm exchange fluids. Nano fluids are created by scattering the nanometric scales strong particles into fluid such as water, ethylene glycol or oils.

2. Review of literature and development in the subject (previous work done in the relevant area)

Nanotechnology is an vital developing zone of inquire about that has been growing intrigued which focuses on the advancement of engineered and organic strategies of building nanoparticles over the globe with tremendous energy in shaping nano transformation due to their wide applications [43, 44, 45]. The different metallic nanoparticles which have picked up tremendous thought in later times due to their crucial significance are silver, gold, platinum, titanium, palladium, press, aluminum and copper [46].These metal nanoparticles have picked up colossal thought in later times due to their vital and innovative significance.

Applications of NPs

Considering the special properties examined in Segment 5, NPs can be utilized in assortment of applications. A few vital of these are given below.

Applications in drugs and medications

Nano-sized inorganic particles of either basic or complex nature, show special, physical and chemical properties and speak to a progressively imperative fabric within the improvement of novel nanodevices which can be utilized in various physical, natural, biomedical and pharmaceutical applications [47, 48, 49].

Applications in fabricating and materials

Nanocrystalline materials give exceptionally curiously substances for fabric science since their properties veer off from individual bulk fabric in a estimate subordinate way. Fabricate NPs show physicochemical characteristics that initiate one of a kind electrical, mechanical, optical and imaging properties that are greatly looked-for in certain applications inside the restorative, commercial, and environmental segments [50-52]. NPs center on the characterization, planning and designing of organic as well as non-biological structures < than 100 nm, which appear interesting and novel useful properties.

Applications within the environment

The expanding range of designed NPs in mechanical and family applications leads to the discharge of such materials into the environment. Surveying the risk of these NPs within the environment requires on understanding of their versatility, reactivity, Eco harmfulness and persistency [53, 54]

Applications in electronics

Printed gadgets with different useful inks containing NPs such as metallic NPs, natural electronic atoms, CNTs and ceramics NPs have been anticipated to flow quickly as a mass generation handle for modern sorts of electronic gear [55]. Interesting basic, optical and electrical properties of one dimensional semiconductor and metals make them the key auxiliary square for a modern era of electronic, sensors and photonic materials [56-58].

Applications in vitality harvesting

Recent thinks about cautioned us approximately the restrictions and shortage of fossil powers in coming a long time due to their nonrenewable nature. Hence, researchers moving their inquire about procedures to produce renewable energies from effectively accessible assets at cheap cost. They found that NPs are the most excellent candidate for this reason due to their, expansive surface region, optical behavior and catalytic nature. Particularly in photocatalytic applications, NPs are broadly utilized to create vitality from photoelectrochemical (PEC) and electrochemical water part [59-61]. Adjacent to water part, electrochemical CO diminishment to powers antecedents, sun based cells and piezoelectric generators too advertised development choices to produce vitality [62-69] NPs moreover utilize in vitality capacity applications to save the vitality into diverse shapes at nanoscale level [70-74]. As of late, nanogenerators are made, which can change over the mechanical vitality into power utilizing piezoelectric, which is an unusual approach to create vitality [75].

Applications in mechanical industries

As uncovered from their mechanical properties through amazing youthful modulus, stretch and strain properties, NPs can offer numerous applications in mechanical businesses particularly in coating, greases and cement applications. Other than, this property can be valuable to realize mechanically more grounded nanodevices for different purposes. It is since; the rolling mode of NPs within the greased up contact region may give exceptionally moo contact and wear portrayed by Guo et al., 2014.

Applications in drug formulations

Nanoparticles can enter the human body, through three fundamental course, coordinate infusion, inward breath and verbal admissions. Once, they enter systemic circulation, particle-protein interaction is the first marvel taking put some time recently dissemination into different organs [76].

Cancer treatment- With keenly outlined nanoparticles, focused on medicate conveyance at the tumor location or a certain bunch of cells does to a great extent maintain a strategic distance from the harmful impacts to other typical tissues and organs [77, 78].

HIV and Helps treatment- This innovation can too be utilized in aide with inoculations to avoid HIV contaminations [43].

International status: Several scientists and researchers working in this field at international level, like - Shafey AME. 2020.
Sibuyi NRS, et al. 2021.
Behzad F, et al. 2021.
Eltaweil AS, et al. 2022.
Hano C, Abbasi BH. 2021.
Melkamu WW, Bitew LT. 2021.
Khan F, et al. 2022.

Kup FO, Çoşkunçay S, Duman F. 2020.
Habeeb Rahuman HB, et al. 2022.

National status: Several scientists and researchers working in this field at national level, like-

Chakraborty N, et al. 2022.
Kharat S.N., Mendhulkar V.D., 2016.
Parveen, K., Banse, V., Ledwani, L., 2016.
Nikalje, A.P., 2015.
Nagarajan, P.K., Subramani, J., Suyambazhahan, S., Sathyamurthy, R., 2014.
Biswas, A.K., Islam, M.R., et al., 2014.
Gujrati, M., Malamas, A., Shin, et al., 2014
Rao, J.P., Geckeler, K.E., 2011.
Rawat, M.K., Jain, A., Singh, S., et al., 2011
Singh, R., Lillard Jr, J.W., 2009.
Bhattacharyya, D., Singh, S., 2009.

3. Objective of the research

The main aim of proposed work is to synthesize and prepare cost effective, ecofriendly, non-toxic - platinum (PtNPs), gold (AuNPs) and silver (AgNPs) using different plant leaf extracts. In proposed work, will be prepared nanoparticles of different biocompatible functions and its various applications useful for socio-economic and future research opportunities in nanotechnology. The research work will carried out for green synthesized NPs used in different industrial areas.

The objectives are as follows:

1. To synthesize the platinum (PtNPs), gold (AuNPs) and silver (AgNPs)via green synthesis method.

2. To prepare the NPs by using Plant sources.

3. To characterize synthesized material and composite materials by UV-Visible, XRD, FTIR, SEM, TEM, and Zeta Potential, etc.

4. To study the suitable methods and quick response for synthesis of nanoparticles from chosen samples.

5. To study the different physicochemical properties of synthesized and characterized NPs.

6. To study the applications of platinum (PtNPs), gold (AuNPs) and silver (AgNPs) in different fields.

4. Methodology

- The NPs will be synthesis using plant sources.
- The NPs will be prepared by using different time span.
- Response of synthesis of NPs will be monitored in light and dark.
- The synthesized NPs will be characterized by XRD, FTIR, SEM, TEM, and Zeta Potential.

- Different physicochemical properties will be studied.
- Rigorous studies on the applications of NPs in various fields.

5. Importance of Study / Social applications:

Green synthesis of NPs is cost effective, ecofriendly easy to prepare. This type of NPs used in many industries, like Pharmaceutical, polymer, semiconductor, lipid based, ceramics, metal, industries, etc. Using green synthesized/ nontoxic NPs very useful in number of fields and it is beneficial to the socio-economical areas. The objective of the present study is that people will know about the NPs and its applications. The proposed work will deal production of new avenues to the researcher in the nanotechnology. It helps to understand how plants extracts and sunlight will produce very quickly NPs within a very short time. Thus, the work may indirectly helpful to the society.

Significance of Study:

The prepared NPs will be biocompatible and eco-friendly as well cost effective. These NPs used in various industries for making number of our daily / life needs. It is already proved by number of researchers / scientists NPs play a vital role in industries.

6. Proposed work plan / formulation and structure of study:

It is proposed to make an intensive literature survey in the green synthesis and its applications in various fields. The nature of synthesized NPs, morphology and its biocompatibility will study rigorously in proposed work. The prepared NPs will be characterized by FTIR, SEM, TEM and XRD for their surface topology at nano-scale, at micro-scale number of cost effective. These NPs used in various industries for making number of cost effective useful in number of fields and it is beneficial to the socio-economical areas. The objective of the present study is that people will know about the NPs and its applications. The proposed work will deal production of new avenues to the researcher in the nanotechnology. It helps to understand how plants extracts and sunlight will produce very quickly NPs within a very short time. Thus, the work may indirectly helpful to the society.

Year-wise plan:-

The following work will be carried out as per the time duration listed below.

First year:- Completion of pre- Ph.D. course work, literature survey, synthesis of NPs, understanding the experimental method, to gain expertise in handling sophisticated instruments like XRD, UV-Vis and FTIR, SEM, TEM understand the nature of NPs.

Second year:- Characterization of synthesized NPs, standardization synthesis process of preparation, preliminary studies on NPs synthesis, characterization by XRD, UV-Vis and FTIR,

SEM, TEM etc. for physical and chemical investigations, participation and presentation in international and national seminars/conferences/workshops/symposium, paper publication.

Third year:- Study the synthesis of NPs by varying time, concentration of the solution, study the applications of synthesized NPs, paper publications, participation and presentation in international and national seminars/conferences/workshops/symposium, thesis writing and submission.

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